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(54) Title: OXIDATION OF DANGEROUS CHEMICAL AND BIOLOGICAL SUBSTANCES

(57) Abstract: Advanced Oxidation Technologies (AOT) using laser triggered and driven AOT platform are disclosed, including a method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, a variety of uses of said method, and the environments where it can be implemented. The method has two basic steps that are; (c) spraying the regions to be treated with a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalytic oxidizing substance; (d) directing across said cloud at least one high intensity beam of light having wavelength of between 220 and 390 nanometer for triggering said cloud thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources. Various types and embodiments of systems and devices using the method of the present invention are also disclosed, including a bubble generator adapted for implementation of the method in various sites where treatment procedures according to the method are required.



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## INTERNATIONAL SEARCH REPORT

International Application No

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61L2/00 A61L2/10 A61L2/16 A61L2/28 B01J19/12  
 C02F1/32 B08B7/00 B65B55/00 A23L3/00 C02F1/00  
 A61C19/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61L B01J C02F B08B B65B A23L A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 43 07 204 A (UNIV SCHILLER JENA) 15 September 1994 (1994-09-15) column 2, line 63 -column 3, line 37 ---	1-18, 20-22,25
A	US 4 289 728 A (PEEL JOHN L ET AL) 15 September 1981 (1981-09-15) column 1, line 15 -column 1, line 43; claim 1	1-18, 20-22,25
Y	column 1, line 32 -column 1, line 52 ---	114,115
A	US 4 661 264 A (GOUDY JR PAUL R) 28 April 1987 (1987-04-28) column 1, line 56 -column 3, line 16 ---	1-18, 20-22,25
A	EP 0 818 206 A (HERAEUS NOBLELIGHT GMBH) 14 January 1998 (1998-01-14) column 1, line 12 -column 3, line 8	1-18, 20-22,25
Y	column 2, line 5 -column 4, line 8 ---	114,115
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

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## INTERNATIONAL SEARCH REPORT

International Application No

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 120 450 A (STANLEY JR E GLYNN) 9 June 1992 (1992-06-09) column 1, line 13 -column 2, line 22 ---	1-18, 20-22,25
A	US 4 744 094 A (MCCARREN DANIEL S) 10 May 1988 (1988-05-10) column 1, line 8 -column 6, line 39 Y column 3, line 6 -column 7, line 38 X column 3, line 6 -column 7, line 38 ---	1-18, 20-22,25 131 114,115
X	WO 00 56464 A (COMBELLACK JOSEPH HENRY) 28 September 2000 (2000-09-28) page 3, line 28 -page 12, line 13 ---	23,24
X	US 5 667 733 A (WALDRON SR DAVID W) 16 September 1997 (1997-09-16) column 3, line 1 -column 5, line 3 ---	23,24
X	WO 99 27970 A (TRIBELSKI ZAMIR) 10 June 1999 (1999-06-10) page 5, line 18 -page 41, line 21 Y claims 1-48; figure 5 X claims 1-48; figure 5 ---	28-30 119-128 117
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X	US 5 364 645 A (LAGUNAS-SOLAR MANUEL C ET AL) 15 November 1994 (1994-11-15) column 1, line 55 -column 7, line 68 ---	28-30
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X	DE 40 32 779 A (WIEDEMANN WOLFGANG PROF DR) 23 April 1992 (1992-04-23) the whole document --- -/--	117

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Section Ch, Week 200135 Derwent Publications Ltd., London, GB; Class D21, AN 2001-329565 XP002208526 & CN 1 255 322 A (PHOTOELECTRIC TECH INST CHINESE ACAD SCI), 7 June 2000 (2000-06-07) abstract	118
Y	---	119-128, 132-135
Y	WO 99 24543 A (BAUSCH & LOMB) 20 May 1999 (1999-05-20) page 6, line 8 -page 15, line 20; example 2	131
Y	----- US 5 298 182 A (LITTLEFIELD SUSAN A ET AL) 29 March 1994 (1994-03-29) column 2, line 51 -column 8, line 10 -----	132-135

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL 01/01137

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 84-113, 116, 129, 130  
because they relate to subject matter not required to be searched by this Authority, namely:  
see FURTHER INFORMATION sheet PCT/ISA/210
2. ☒ Claims Nos.: 19, 26, 27, 31, 38-83, 137, 138  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

## Continuation of Box I.1

The claims relate to a method for sterilizing and disinfecting blood and bodily fluids within the body, albeit non-invasively, respectively therapeutic applications of methods and devices according to the application.

These actions must clearly be considered to represent a medical treatment which is not patentable.

## Continuation of Box I.1

Claims Nos.: 84-113,116,129,130

Claims 84-113,116,129 and 130 relate to methods for sterilizing e.g blood (non-invasively) respectively therapeutic applications of devices or methods according to the application.

These are methods for treatment practised on the human or animal body which are regarded as inventions not susceptible of industrial application, these claims were thus not searched.

## Continuation of Box I.2

Claims Nos.: 19,26,27,31,38-83,137,138

1. The claims (and the description), over large parts, are drafted in a language that cannot be understood simply due to the fact that the application is not written in colloquial English.

2. Moreover, the claims comprise a multitude of features of completely different nature which are unclear as such (and are not discussed, let alone explained) in the description.

What more is, they contain a multitude of alternatives leading to claims that, as far as they can be understood, are so broad that there is no meaningful search possible.

3. They contain expressions that are unclear (what is "structurally yielding Oxygen charged U.P.W. (ultra pure water), pH-stabilized (at which pH ?), carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed laser light"), see claims 38-83.

To conclude, the claims cannot be searched.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

receipt of the search report or during any Chapter II procedure.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-18,20-22,25

The first invention relates to a method (and corresponding use and system) for oxidizing hazardous chemicals and biological substances by spraying a cloud of defined origin (meaning that the cloud, in its final form, may be a pure gas phase or a suspension) over the region and directing the laser into the formed cloud.

The remaining inventions discussed below do not comprise the feature relating to the cloud.

The laser irradiation of devices in conjunction with e.g. H<sub>2</sub>O<sub>2</sub> is known from the prior art and cannot establish unity. Unity of the first invention stems from the irradiation of the "cloud" which therefore forms the basis of the common inventive concept for the first invention.

2. Claims: 23,24

The second invention relates to a bubble generator for forming a cloud. The intended use does not change the scope of the claim directed to the bubble generator as such. Novelty is highly doubtful (consider any spraying device).

3. Claims: 28,29,30

The third invention relates to lasers as such resp. any device comprising the laser as defined in the claims. The claims are not linked by a single inventive concept to the first invention.

4. Claims: 31-37

The fourth invention relates to a device for catalytic surface treatment for e.g. containers or packaging materials. It cannot be seen that there is a treatment involving the use of a gaseous "cloud" involved, thus there cannot be unity with the previous inventions.

5. Claims: 114-115

The fifth invention relates to methods and devices used for hygiene applications. The claims are not confined to treatment with the help of a cloud; rather UV is used directly or in combination with a gel etc.

6. Claim : 117



FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

The sixth invention relates to the method and device for dento-medical applications involving an acatalytic toothpaste with the use of an optronic tooth-brush. There is no connection with the first invention.

7. Claims: 118-128

The seventh invention relates to dental application involving a photocatalytic toothpaste. There is no gaseous catalytic cloud involved and there is no common inventive concept with the first invention.

8. Claim : 131

The eighth invention relates to a treatment of a target (any) by laser with the help of a water-based system the phase of which is undefined. There is no reference to a cloud; unity cannot be given.

9. Claims: 132-135

The ninth invention relates to multi-component-systems as such; there is no link with the first invention as the intended use cannot be derived from the compositions as such.

10. Claim : 136

The tenth invention relates to a device for disinfecting basically consisting of a laser and a wave-guide. There is no photocatalytical chemical agent nor a cloud; thus there is no single inventive concept with the first invention.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IL 01/01137

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